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Abstract

This paper uses a flex-price open economy macro model to examine the effectiveness of U.S. monetary and fiscal policies when the dollar floats freely against the euro, but is fixed against the Chinese yuan. It is assumed that capital mobility is high between the U.S. and the Eurozone, but low between the U.S. and China. The model allows for short-run price flexibility and imperfect substitutability between domestic and foreign financial assets.

The focus is on the implications for the efficacy of U.S. macro stabilization policies of China's fixed-rate strategy. While many countries have pegged their currencies to the dollar, China is large enough to have an impact. It is shown that its large size enables China to impede the effectiveness of U.S. macroeconomic policies. Indeed, while the U.S. is officially tagged as an independent floater, Chinese intervention is capable of interfering with dollar-euro flexibility and thereby creates outcomes that are more consistent with policy under fixed rates.

KEYWORDS: open economy macro, exchange rate regimes, U.S.-China payments adjustment

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1. Introduction

A widely used approach in modeling the role of the exchange rate in open-economy macroeconomics is to assume that a country is either a pegger against the rest of the world or a floater. In that spirit, the International Monetary Fund (IMF) classifies the United States as an "independent floater." While this is an appropriate interpretation of (*de jure*) U.S. policy, it does not accurately reflect the country's *de facto* exchange-rate regime. That regime is a combination of floating rates against most countries and a fixed rate against the *renminbi* (RMB) or yuan, fixed by intervention of the Chinese monetary authority.

The object of this paper is to explore the implications of such a mixed exchange-rate regime for (i) the effectiveness of domestic macro stabilization policies and (ii) the transmission of foreign shocks and disturbances. The analysis is carried out with the aid of a medium-term open-economy macro model with prices and output both flexible (implying a positively sloped aggregate supply curve) and with capital mobility high between the U.S. and the Eurozone and low between the U.S. and China.[1] A final section examines the implications of production sharing between the U.S. and China for adjustment at the macro level. It is shown that China's exchange rate policy has material implications for U.S. macro policy autonomy and for the effect of foreign shocks on the U.S. economy. A particularly important consequence is that Chinese intervention, and the manner in which dollars are recycled into circulation in the U.S., interferes with the "automatic" adjustment mechanism in the American economy.

Section 2 provides an outline of the model and derives solutions for the benchmark scenario of a freely floating dollar against both currencies. Section 3 works out the mixed-regime scenario and provides an assessment of the U.S.-China policy debate over the causes of the bilateral current account imbalance. Section 4 focuses on the international transmission of economic shocks and disturbances in a mixed-rate regime and shows that fixing causes the U.S. economy to become more exposed to cyclical disturbances in China.. Section 5 examines the implications of production fragmentation between the U.S. and China and Section 6 concludes.

2. Freely Floating Rates Everywhere

In this section, the dollar is assumed to float freely against both the euro and the yuan. This is the preferred regime, according to Washington policy makers who continue to press China to allow the yuan to float against the dollar. The results of

[1] For an analysis of some of these issues in a sticky-price model, see Arndt (2011).

this section will thus serve as a benchmark against which to evaluate the outcomes associated with the actual mixed-rate regime.

The model in this paper is one that is familiar to and used by most policy makers. It is based on the Mundell-Fleming (MF) model, but allows for price flexibility. Hence, rather than being flat, the aggregate supply curve is positively sloped. The broad effect of this change in structure is to reduce the response of income and employment to policy initiatives, because some portion of the energy of policy stimuli is absorbed into price changes. It also introduces an additional source of changes in real exchange rates.

The basic structure of the model is given by the well-known equilibrium conditions for the money market, the goods market and the balance of payments. The money market is specified as follows:

$$H/P = \mathrm{L}(y, i), \tag{1}$$

where H represents the monetary base, P is a general price index, y is real gross domestic product, and i is a nominal interest rate or structure of nominal interest rates. The real demand for money, L, responds positively to income or output and negatively to the rate of interest.

Goods market equilibrium is specified as follows:

$$\mathrm{I}(i) + \mathrm{T}(y, y^*, y^\wedge; e^*, e^\wedge) - \mathrm{S}(y) = -G, \tag{2}$$

where I is real capital formation, T is the trade balance or current account, S is private-sector saving, G represents the government budget deficit, y* and y^ stand for Eurozone and Chinese GDP, respectively, and e* and e^ represent the dollar's real exchange rate with respect to the euro and the yuan, respectively. The real exchange rate is defined as the nominal rate E (expressed as the dollar price of the respective foreign currency) multiplied by the ratio of the respective foreign price level to the U.S price variable, P. Investment responds negatively to the rate of interest; the current account worsens with a rise in U.S. income, but improves with foreign GDP and improves with a rise in either real exchange rate. Private sector saving is positively related to domestic GDP.

There are two balance-of-payments equilibrium conditions, one for the Eurozone, the other for China.

$$\mathrm{T}^*(y, y^*, e^*) + \mathrm{K}^*(i, i^*) = 0, \tag{3a}$$

and

$$\mathrm{T}^\wedge(y, y^\wedge, e^\wedge) + \mathrm{K}^\wedge(i, i^\wedge) = 0, \tag{3b}$$

where capital inflows respond positively to the domestic interest rate and negatively to the respective foreign rates. As noted above, capital mobility with Europe is assumed to be high, while that with China is low.

The aggregate supply curve is modeled as follows:

$$P = P(y),\ P_y > 0. \tag{4}$$

Monetary Expansion

The effects of a monetary expansion in the United States are summarized in Figure 1. The curves are familiar from the standard open-economy macro model, except that all slopes will generally be steeper as a result of the assumption of price flexibility. The steeper of the two balance-of-payments curves, B^B^ reflects the low degree of capital mobility vis-à-vis China. A monetary expansion shifts out the LL curve. The rise in domestic GDP and decline in the domestic rate of interest worsen both current accounts and both financial accounts. There is unambiguous pressure on the dollar to depreciate against both currencies. These depreciations shift the goods-market equilibrium and the two balance-of-payments functions to the right.

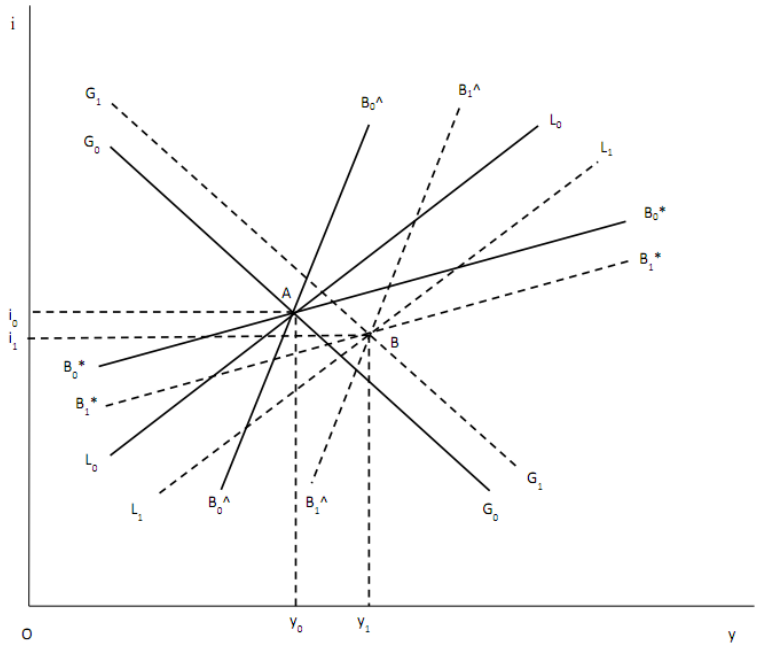

Figure 1

At the new equilibrium, B, domestic income has risen, but by less than in the standard model, because the domestic price level has also increased. The magnitude of this price-adjustment effect depends on the slope (P_y) of the aggregate supply curve. The rise in U.S. prices implies that the dollar's real depreciation is smaller than the nominal depreciation with respect to both currencies. If purchasing power held before the shock, it no longer does in the new equilibrium. The relative magnitudes of the real depreciations depend on the values of both trade and financial account parameters.

Fiscal Expansion

The effects of an expansionary fiscal policy (dG>0) are summarized in Figure 2. The rise in government expenditures shifts out the goods market equilibrium function. The consequent rise in domestic GDP worsens both current accounts, while the rise in the domestic interest rate improves the financial account with the Eurozone by more than enough to offset the current account deterioration, but by less than is needed to offset the deterioration of the current account with China. There is thus pressure for the dollar to appreciate against the euro and to depreciate against the yuan. This has the effect of shifting the B*B* curve to the left and the B^B^ curve to the right. In the new equilibrium, they will have to intersect somewhere on the stationary LL curve. The exact location of that intersection depends on adjustment in the goods market.

The goods-market line is subject to two opposing pressures, with the euro depreciation tending to push it to the left and the yuan appreciation tending to push it to the right. The actual direction of movement depends on the relative strengths of these two effects. If they are equal, there will be no further movement of the GG curve and the final equilibrium will, as shown, lie at the point of intersection of the G_1G_1 and LL curves.

In that event, the policy's effectiveness will not differ from that of the closed-economy case. If dollar-euro adjustment is the dominant force, then the G_1G_1-line shifts left and policy effectiveness is weakened. If dollar-yuan adjustment dominates, then the line shifts to the right and policy effectiveness is strengthened.

Hence, ironically, low capital mobility between the U.S. and China, which is to a significant extent the result of capital and exchange controls in the latter, serves to strengthen the effectiveness of U.S. fiscal policy.

The dollar's real appreciation against the euro is reinforced by the rise in the domestic price level. The dollar's real depreciation against the yuan is made smaller than its nominal depreciation by the rise in the U.S. price level.

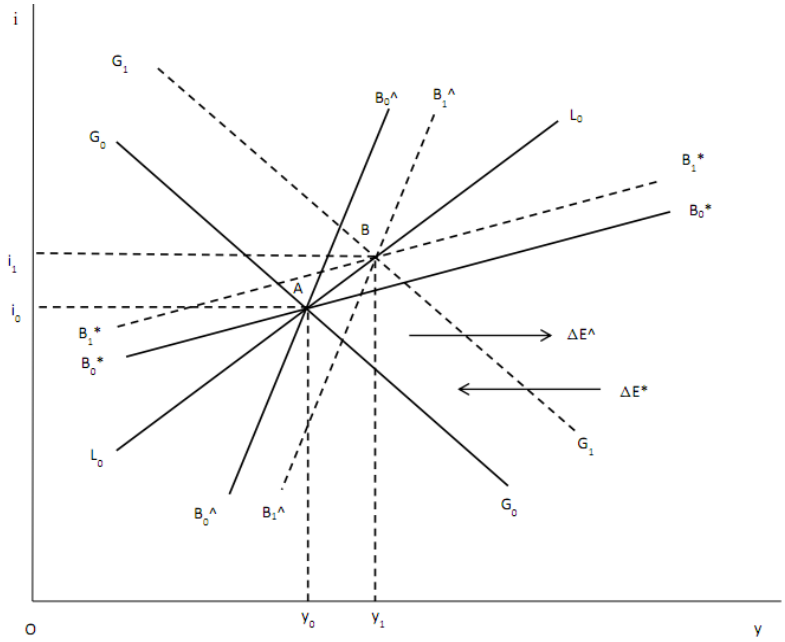

Figure 2

3. The Euro Floats While the Yuan is Fixed

In this section, it is assumed that China intervenes in the foreign exchange market in order to prevent the yuan's value from changing against the dollar. When the Chinese central bank intervenes to prevent the yuan from appreciating, it pulls dollars out of circulation, which has the same effect on U.S. money supply as would an intervention by the Federal Reserve. When the Chinese central bank uses these dollars to purchase U.S. Treasury securities in the open market, the effect is to offset the reduction in U.S. money supply brought about by the intervention itself. The result is well-known in the literature on sterilized exchange-market intervention: U.S. money supply is unchanged, the automatic adjustment mechanism for fixed-rate regimes is frozen, and the imbalance in the China-U.S. bilateral balance of payments is made "permanent".

The shift in the Chinese exchange-rate regime from floating to fixed requires a change in our specification of money market equilibrium. As in the previous case, base money is adjusted by the Fed through changes in domestic credit via standard open-market operations. When China intervenes to absorb an excess supply of dollars in the foreign exchange market, the result is to reduce base money in the U.S., very much like a Fed intervention (of selling yuan for

dollars) would reduce base money. When the central bank of China follows up by purchasing U.S. Treasuries, the foregoing reduction in base money is offset.[2]

Monetary Expansion

The effects of a monetary expansion in the context of this mixed regime are summarized in Figure 3. The initial effect is to shift the LL curve to the right, which tends to reduce interest rates and raise domestic output and prices. With respect to the euro, both the current account and the financial account with the Eurozone deteriorate, thereby generating pressures for the dollar to depreciate against the euro. This tends to push both the GG curve and the B*B* curve to the right.

The rise in income and decline in domestic interest rates tend also to worsen both sides of the U.S. balance of payments with China. In order to prevent the yuan from appreciating against the dollar, the Chinese authorities intervene in the foreign exchange market in order to absorb the excess supply of dollars, after which they convert these dollars into U.S. Treasury securities. In combination, these two actions maintain the U.S. money supply at its new level.

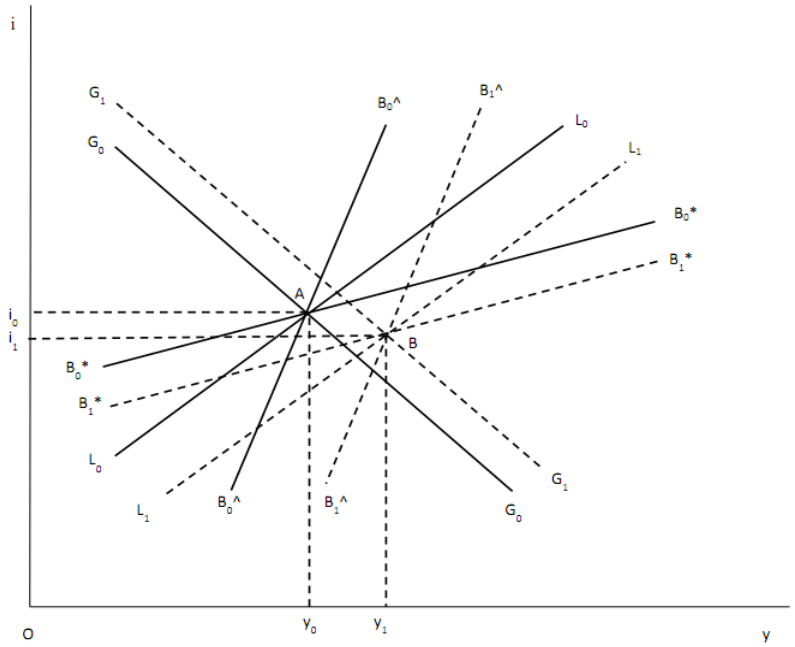

Figure 3

[2] For an intermediate scenario in which the Chinese authorities purchase Treasury securities directly from the Fed, see Arndt (2011). In that scenario, the automatic adjustment mechanism continues to function.

We rewrite the equilibrium condition for the U.S.-China balance of payments in order to reflect the fact that any imbalance in autonomous transactions will always be met by an offsetting transaction on official reserve account:

$$T^{\wedge}(y, y^{\wedge}, e^{\wedge}) + K^{\wedge}(i, i^{\wedge}) + R^{\wedge} = 0, \tag{3c}$$

where R^ represents the level of dollar reserves held by the Chinese authorities and where dE^ = 0. While the nominal exchange rate is fixed, the flexibility of U.S. prices in this model makes room for changes in the real rate of exchange between the two countries.

Returning to Figure 3, we note that the new LL curve is now the anchor for the system in the sense that the new equilibrium must lie somewhere on that function. Suppose that the new goods-market and U.S.-Europe balance-of-payments curves meet at point B on the new LL curve. The combination of interest rate and income represented by that point leaves the autonomous U.S.-China balance of payments in deficit, i.e., the sum of the first two terms in equation (3c) is negative. This requires the Chinese central bank to accumulate dollars in perpetuity or until the U.S. central bank reverses its easy-money policy.[3] The B^B^ curve through point B thus reflects a balance of payments equilibrium in which a U.S. deficit in autonomous transactions is just covered by Chinese reserve accumulation.

At point B the dollar has depreciated against the euro in both nominal and real terms. It has remained unchanged against the yuan in nominal terms, but has *appreciated* against the Chinese currency in real terms. This appreciation is the result of the increase in the U.S. price level.

Fiscal Expansion

The effects of a U.S. fiscal expansion are summarized in Figure 4. The policy stimulus moves the GG curve to the right, tending to raise income and the rate of interest. As in the previous section, the rise in income causes both current account balances to deteriorate, while the higher interest rate attracts capital inflows from both countries. In the case of the Eurozone, where capital mobility is high, the improvement in the bilateral financial account exceeds the deterioration in the current account, thereby putting pressure on the dollar to appreciate against the euro. This appreciation causes the GG and B*B* curves to shift left. This is the familiar finding that high capital mobility reduces the effectiveness of fiscal policy.

[3] A later section considers some of the implications for the ongoing debate between the U.S. and China on who is responsible for and what should be done about the sustained current imbalances.

On the Chinese side, low capital mobility limits the improvement of the financial account, so that the balance on autonomous payments deteriorates. Under floating rates, the dollar would depreciate against the yuan, thereby tending to strengthen the effectiveness of the fiscal expansion. The central bank of China prevents the yuan from appreciating by soaking up the excess supply of dollars and converting them into Treasury securities. The new B^B^ curve through point B represents a balance-of-payments equilibrium in which the deficit in autonomous transactions is just offset by reserve accumulation on the part of the Chinese authorities.

At point B, the dollar has appreciated against the euro in both nominal and real terms; it has remained fixed in nominal terms against the yuan, but has appreciated in real terms against the Chinese currency. This additional boost to the real value of the dollar worsens the imbalance between the U.S. and China, but it is important to keep in mind that this model does not take into account possible price increases in China.

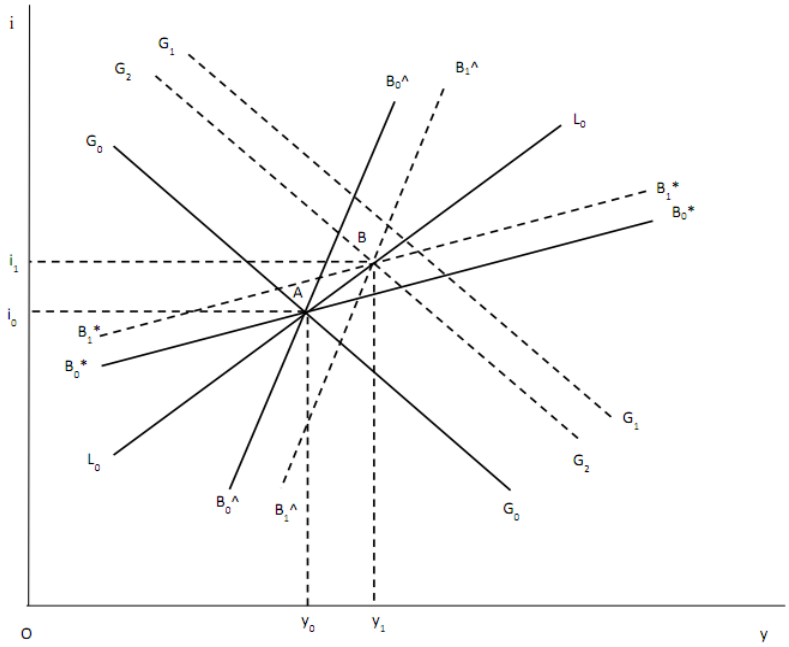

Figure 4

Lessons for the China-U.S. Policy Debate

The persistent China-U.S. current account imbalances continue to be a significant irritant in relations between the two countries. Many U.S. commentators and politicians tend to blame China's policy of fixing the yuan to the dollar at levels that may be too low. High and steadily rising levels of China's foreign-exchange

reserves are cited as the primary piece of evidence that the yuan is undervalued. China's response has been to use the national income identity to argue that the problem is "made in the U.S.A." and arises from imbalances in the country's public finances and private sector saving and investment.

Although the model used in this paper is not fully suited to resolving the debate, it does offer some useful insights. First, the discussion in Section 2 shows that a flexible yuan would indeed restore balance in autonomous transactions. It does not say that there could not exist continuous current account imbalances, financed by financial account imbalances of equal magnitude and opposite sign. The cases captured by Figs. 1 and 3 taken together suggest that a shift by China from fixed to floating rates would cause the yuan to appreciate against the dollar, would reduce the bilateral current account imbalance, and would boost output and employment in the United States.

The discussion in earlier sections has underscored the role of low capital mobility between the U.S. and China in driving the results. Thus, another way in which China could alleviate the imbalance problem is to eliminate or reduce controls on capital movements, thereby allowing Chinese households, firms, and organizations to expand their portfolios toward foreign-currency-denominated assets. Paired with a fixed exchange rate, this policy would spread accumulation of foreign assets away from the central bank to the rest of the Chinese economy. Among the many benefits would be asset diversification and better returns. It would sharply reduce the gap between the current value of the yuan and its equilibrium or market-clearing value on the assumption that there is within China a pent-up private demand for dollar and other foreign assets. This reduction in the misalignment of the bilateral exchange rate would not only cool the rhetoric in Washington, but reduce the threat to small and medium-sized firms in China's leading export sectors of a move to greater exchange-rate flexibility.

As for the "made-in-America" argument, deficit reduction in the U.S. would have results opposite to those discussed in connection with Figure 4: it would reduce the bilateral imbalance. A rise in private sector saving, which has occurred in the aftermath of the financial crisis, would also have that effect. The downside of this strategy is that its short-run effect would be to reduce output and employment and thus to aggravate the economic situation in the U.S.

Finally, when the Chinese central bank recycles intervention dollars by purchasing U.S. government securities from the public or directly from the Treasury, it essentially neutralizes the forces that would work to restore balance in the foreign exchange market. The Fed might want to implement a strategy of selling Treasury securities directly to the Chinese authorities and thereby make room for the contraction of money supply that would follow.

4. Cross-Border Transmission

Most economies have become significantly more open in recent years, with more extensive linkages among domestic and foreign markets for goods, services, and assets. One of the consequences may be that shocks and disturbances are more easily transmitted from one country to another, allowing for the usual caveats pertaining to transaction, transportation, and communication costs. In goods and services trade, an important contributor to this development has been the growth of cross-border production networks, which means that a downturn in demand in a country like the United States spreads to other countries not only via traditional "horizontal" channels, but by "vertical" channels along the value-added chain.

In the financial arena, greater market integration means that risky or contaminated assets held by financial institution in one country, create problems not only for the immediate parties involved, but for lenders and investors in third countries, who have provided funding to the process.[4] These often complex and opaque linkages are at least partly to blame for the growing role of contagion effects.

The nature and extent of cross-border transmission of shocks and disturbances depends on the exchange rate regime. In the model of this paper, flexible exchange rates provide significant insulation. In the first scenario, when the dollar floats against both currencies, a change in income growth in either China or the Eurozone has no effect on U.S. GDP or interest rates. Its only effect is to cause the expanding country's currency to appreciate against the dollar. This appreciation exactly offsets the stimulus emitted by the growth increase.

When the Chinese exchange rate is fixed along the lines of the second scenario, however, there is transmission. As shown in Figure 5, a rise in Chinese GDP initially shifts goods-market equilibrium and the U.S.-China autonomous payments curve to the right. Under high capital mobility, the dollar appreciates against the euro, which moves the new G and B* curves to the left. The B^ curve running through point B represents overall payments equilibrium between the U.S. and China (while the B_1^ curve represents equilibrium in autonomous transactions only). Hence, the distance between those curves represents the period-by-period decline in Chinese foreign-exchange reserves. Thus, a rise in Chinese growth raises U.S. GDP. In this model, at least, the rapid Chinese growth in recent years would not have had the beneficial effects on U.S. economic activity if there had been a floating rate between the two currencies.

[4] This recalls a feature of the European sovereign debt crisis, where suspect Greek government bonds undermine confidence not only in German and other European banks who made the initial loans, but in the U.S.-based money-market funds who provided some of the funding.

Finally, again in the second scenario of a mixed exchange-rate regime, faster growth in the Eurozone has no effect on the U.S. economy. Its only consequence is to cause the dollar to appreciate against the euro.

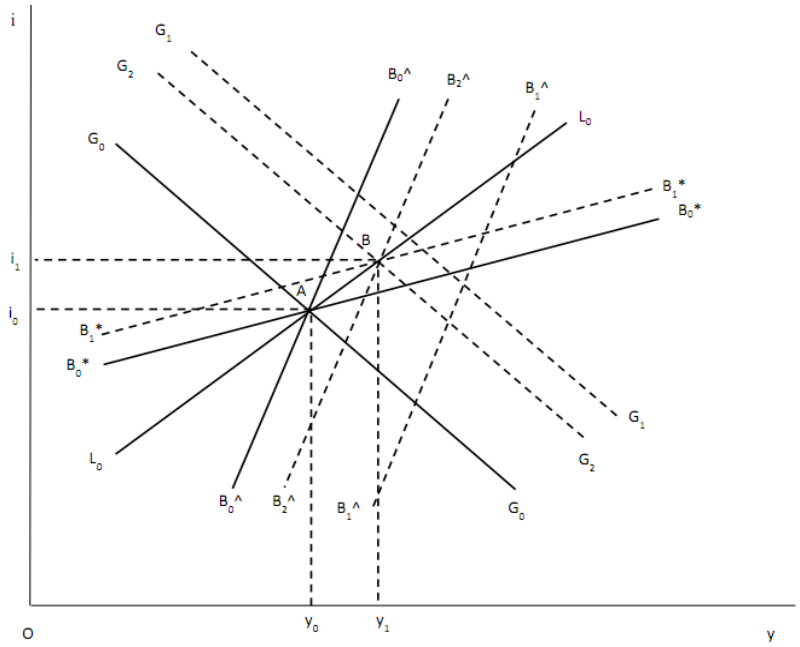

Figure 5

5. Production Sharing and Vertical Intra-Industry Trade

Cross-border production networks and vertical intra-industry investment and trade have grown rapidly in recent years, helped along by increasingly open and interlinked economies and important cost-saving innovations in transportation and communication technologies. As a result, trade in intermediates, parts and components has seen significant growth relative to other forms of trade. Indeed, the share of such transactions in total trade has become large enough to affect adjustment at the macro level. As Arndt & Huemer (2007) and others have shown, vertical intra-industry trade reduces the sensitivity of the trade balance and current account to movements in exchange rates. Arndt (2010) has argued that the growth of direct links between a country's exports and imports, which are typical of vertical intra-industry trade, alter response functions and adjustment patterns in a standard open-economy macro model of the Mundell-Fleming type.

An additional feature of vertical intra-industry trade is that it exposes *non-traded* goods and services directly to variations in exchange rates and to competition from abroad. This follows from the fact that production of non-traded goods may contain tradable components and non-traded services may contain

tradable constituent activities. For example, X-ray procedures may not be tradable, but reading and analyzing X-ray images are tradable activities. Hence, the total cost of an X-ray procedure will rise with depreciation of a country's currency if image analysis is outsourced to a foreign operator.

It is possible to explore the implications of such developments in the context of the present model by rewriting equation (4) to include an exchange-rate effect. We assume that the share of components trade between the U.S. and China is large enough to imply that a dollar depreciation against the yuan shifts the aggregate supply curve up and we model that effect as follows:

$$P = P(y, E^{\wedge}). \tag{4a}$$

The main consequence is to introduce a direct effect of exchange-rate changes into the money demand function, so that variations in the dollar-yuan exchange rate move the LL curve under floating rates. As suggested earlier, another effect is to reduce the responsiveness of the GG and B^B^ curves to variations in exchange rates. This makes exchange-rate variability a less forceful instrument for payments adjustment.

6. Concluding Remarks

Over the decades, many countries have unilaterally fixed their currencies to the U.S. dollar. Countries in Latin America and in East Asia have been among them. Since they have tended to be small relative to the huge U.S. economy, their pegging policies have not aroused much concern in the United States. By and large, they have not seemed to interfere with U.S. policy-making autonomy.

The People's Republic of China also unilaterally pegs the yuan to the dollar, but its economy is large. As the ongoing debate over the implications of this policy suggests, it has become a major irritant to the U.S. From the point of view of many American businesses, the "undervalued" level at which the yuan is fixed gives China an unfair competitive edge in trade relations between the two countries. The policy also contributes to the large bilateral current account imbalance and to rising U.S. indebtedness to China.

A third issue, which has received less attention, concerns the extent to which unilateral pegging by China interferes with U.S. macroeconomic policy autonomy. This question is examined in the preceding pages with the aid of a medium-term open-economy macro model in which both prices and output are flexible. The focus is on the effectiveness of U.S. monetary and fiscal policies and the transmission of foreign disturbances to U.S. economic activity. A key assumption throughout is that capital mobility is high between the U.S. and the

Eurozone and other countries against which the dollar floats, but low between the U.S. and China.

The model is first solved for the system preferred by the U.S., namely, universal flexible exchange rates. This is the benchmark result against which the *de facto* alternative of a mixed-rate regime is compared. It is shown that China's pegging policy does affect the efficacy of U.S. macro policies, in part because China uses the dollar as its main reserve currency. By recycling intervention dollars into U.S. Treasury securities, China contributes to the "permanent" nature of the bilateral current account imbalance.

It is also shown that growth spurts from China to the U.S. have positive effects in the U.S. compared to growth spurts from the Eurozone. In the context of the recent recession in the U.S., that may actually have been a desirable result of China's policy.

An important element in U.S.-China trade relations is the importance of production networking and processing trade. These features are shown to affect the nature and efficiency of trade-balance adjustment in ways that do not exist in U.S. trade with the other countries in the model.

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